United States Patent [19]

Müller

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[54] **PISTON DRIVE**

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**[5] **F01B 31/14**

[52] **U.S. Cl.** **92/13.5**; 92/13; 92/13.6; 92/128

[58] **Field of Search** ..... 92/13, 13.2, 13.4, 13.41, 92/13.5, 13.6, 128, 145; 251/285 X

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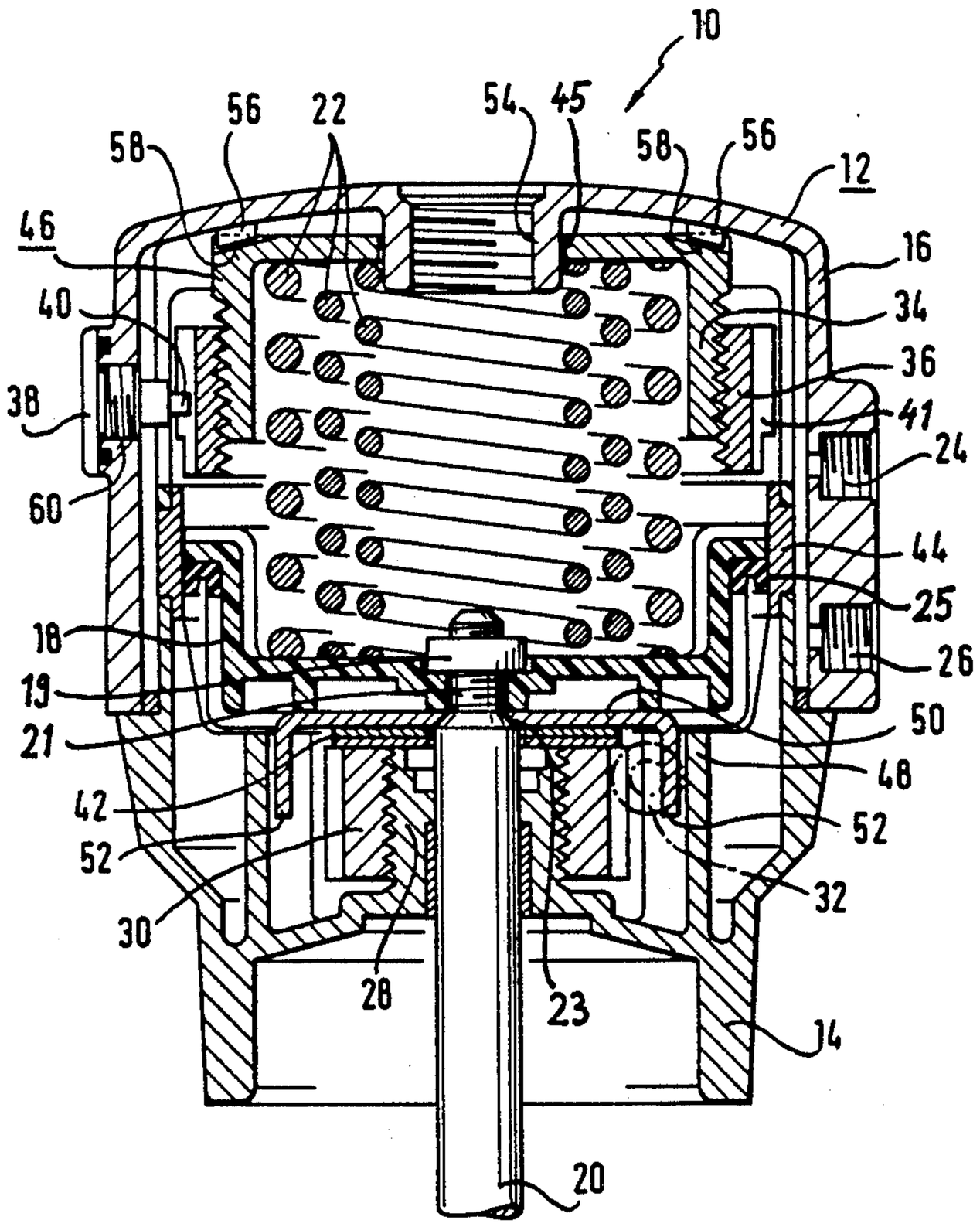
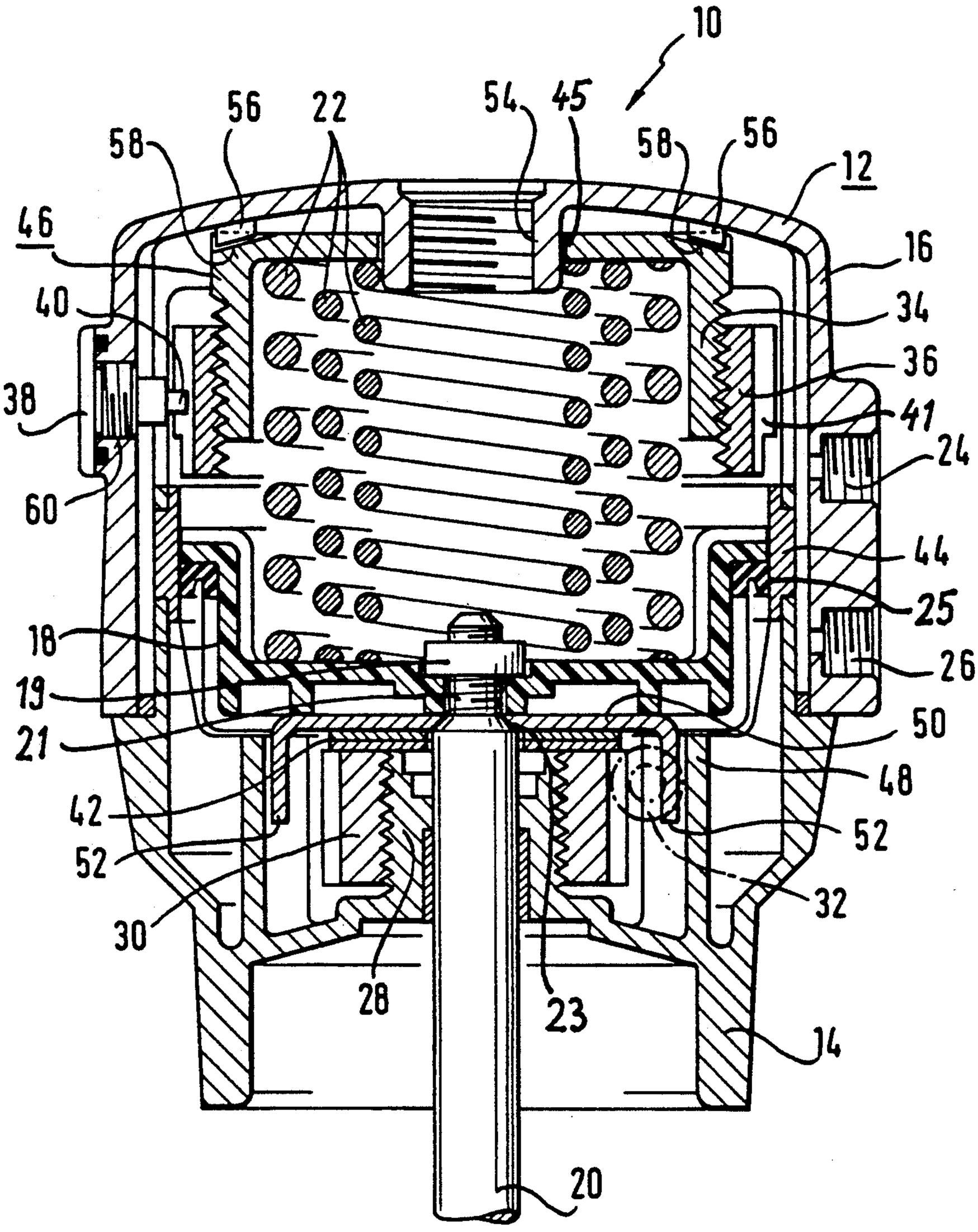
[57] **ABSTRACT**

A piston drive e.g. for actuating a valve includes a piston which reciprocates in axial direction within a housing between two end positions, with one end position being defined by a worm drive including a manually actuated worm which actuates a worm wheel movable in axial direction and defining a stop for the piston. The other end position is defined by a gear which is arranged in the path of movement of the piston and is provided with an internal gear meshing with the external thread of a stationary connecting piece of the housing. The gear is turned relative to the connecting piece and thus moved in axial direction by a tool which is insertable through a bore in the housing from the outside.

13 Claims, 1 Drawing Sheet

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PISTON DRIVE

BACKGROUND OF THE INVENTION

The present invention refers to a piston drive, in particular to a piston drive for actuating a valve or the like.

In general, piston drives are known which include a housing accommodating a suitably sealed reciprocating piston linked to a piston rod acting upon an operating device such as a valve in dependence on the stroke of the piston.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved piston drive which is of simple constructive design and yet reliable in operation.

This object and others which will become apparent hereinafter are attained in accordance with the present invention by providing a worm wheel which acts upon the piston and is provided with an internal thread in mesh with the external thread of a nipple of the housing so as to be movable in axial direction in order to define one of the end positions between which the piston reciprocates.

According to a further feature of the present invention, the other end position may be defined by a gear which projects into the path of movement of the piston and is axially movable along the external thread of a stationary connecting piece which is mounted to the housing. In the area of the gear, the housing is suitably provided with a threaded opening through which a tool may be inserted to reach into the tooth space between two adjoining teeth of the gear for turning the gear and thus for attaining its axial displacement.

Preferably, the threaded opening is closable by a plug provided with a radial projection which protrudes into the tooth space between two adjoining teeth to lock the gear.

BRIEF DESCRIPTION OF THE DRAWING

The above and other objects, features and advantages of the present invention will now be described in more detail with reference to the accompanying drawing in which:

The sole FIGURE shows schematically a longitudinal section of one embodiment of a piston drive in accordance with the present invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to the sole FIGURE of the drawing, there is shown a longitudinal sectional view of a piston drive generally designated by reference numeral **10**. The piston drive **10** includes a housing **2** with a lower housing part or base **14** and an upper housing part or lid **16**. The housing parts **14**, **16** are suitably connected to each other for example through threaded engagement via respective screws (not shown). Accommodated in the housing **12** is a piston **18** which reciprocates in axial direction between two end positions and is guided in a piston bushing **44**.

Centrally mounted to the piston **18** via a nut **19** is the threaded end **21** of a piston rod **20** which extends beyond the axial end of the housing **12** for allowing attachment of a suitable device such as e.g. a diaphragm of a diaphragm valve which is actuated by the piston **18** for example for opening and closing the valve. The

threaded end **19** of the piston rod **20** is of reduced diameter and connected to the main portion of the rod **20** via a conical part **23**, the purpose of which will be described hereinafter.

The piston as illustrated in the exemplified embodiment as shown in the FIGURE is designed as a multipart element and includes the actual piston **18** which is made of plastic material and suitably sealed by a seal **25** and a reinforcing element **50** for the piston **18**. The reinforcing element **50**, which is made of metal such as e.g. sheet steel, extends at the underside of the piston **18** and rests on the conical portion **23** of the piston rod **20**. It will be appreciated, however, that instead of the illustrated multipart piston, it is certainly feasible to design the piston as a one-part element.

Acting upon the top side of the piston **18** are a plurality of compression springs **22** which urge the piston **18** in downward direction for closing the not shown valve At a suitable lateral location, the housing **12** is provided with an inlet port **26** and an outlet port **24** for circulation of a pressure fluid such as compressed air. The pressure fluid is supplied to the inlet port **26** and introduced into the housing **12** at an area below the piston **18** to thereby allow the piston **18** to be axially shifted upwardly against the force exerted by the compression springs **22** and to open the valve which is linked to the piston rod **20**.

In order to adjust the lower end position of the piston **18**, the lower housing part **14** of the housing **12** is provided with a nipple **28** which axially projects upwardly concentric to the center axis of the housing **12** and includes an external thread meshing with the internal thread of a worm wheel **30**. As shown in the FIGURE, the nipple **28** serves also as guide for the piston rod **20**.

The worm wheel **30** forms a part of a worm drive which further includes a worm **32** which is only schematically indicated by dash-dot line. It should be noted that the illustration of the FIGURE shows the worm **32** turned by 90°. In reality, the worm **32** lies behind the sectional plane of the FIGURE and extends beyond the housing **12** so as to allow manual actuation thereof from the outside.

Thus, by suitably actuating the worm **32**, the worm wheel **30** turns and is shifted in axial direction along the stationary nipple **28** to thereby allow adjustment of the lower end position of the piston **18**.

Suitably, one or more disks **42** may be loosely sandwiched between the piston **18** i.e. its reinforcing element **50** and the worm wheel **30** in order to evenly transmit the forces between the worm wheel **30** and the piston **18**. In the embodiment as shown in the FIGURE, two such disks **42** are provided.

In order to define a lowermost end position of the piston **18**, the lower housing part **14** is further provided with an upwardly projecting flange **48** which extends in the path of movement of the piston **18** to provide a stationary and unchangeable stop member.

As is further shown in the FIGURE, the reinforcing element **50** is provided with two axially downwardly bent projections **52** which engage complementary grooves or recesses (not shown) in the housing **12** to prevent a rotation of the reinforcing element **50** and the linked piston **18**. It will be appreciated that the reinforcing element **50** may also be provided with only one such projection **52** or with more than two such projections **52**.

The lower end position of the piston **18** is thus easily adjustable by means of the worm drive by suitably operating the worm **32** and the worm wheel **30**. If desired, the lower end position of the piston **18** can be selected in such a manner that the valve to be operated by the piston drive **10** is still slightly opened even when the piston **18** occupies its lower end position in order to ensure a minimum passage through the valve. Further, the worm drive allows also an actuation in emergency situations such as failure of the electric control mechanism or of the supply of compressed air. In these situations, the piston **18** can still be raised or lowered manually in axial direction so as to open or close the valve which is linked to the piston **18** via the piston rod **20**.

For adjusting the other, upper end position of the piston **18** and thus for adjusting the stroke thereof, the upper housing part **16** of the housing **12** is provided with a central, inwardly directed socket **54** which extends through a bore **45** of an insert **46** of inverted cup-shape. The insert **46** which is thus retained in centered position by the socket **54** includes a cylindrical connecting piece **34** which is provided with an external thread meshing with the internal thread of a gear **36**. The compression springs **22** which act upon the piston **18** with their one end to urge the piston **18** in downward direction bear with their other end against the insert **46** to urge the latter against the inner end face of the upper housing part **16**.

The insert **46** is stationarily placed within the upper housing part **16** of the housing **12** via the socket **54** and secured against rotation by suitable means such as lugs **56** which project from the upper housing part **16** and engage in complementary grooves **58** of the insert **46**. As shown in the FIGURE, the gear **36** faces the piston **18** and thus extends in the path of movement of the piston **18** so as to provide a stop member for the movement of the piston **18** in upward direction. By respectively turning the gear **36** relative to the connecting piece **34**, the gear **36** is movable upwardly or downwardly in axial direction to adjust the upper end position of the piston **18** i.e. the stroke of the piston **18**.

The adjustment of the gear **36** in axial direction is attained by a suitable tool e.g. a screwdriver (not shown) which is insertable into the tooth space between two adjoining teeth **41** of the gear **36** through a bore such as threaded opening **60**. Suitably, the opening **60** is arranged on the side of the upper housing part **16** in vicinity of the gear **36** i.e. opposite to the teeth of the gear **36**. Thus, by inserting the tool into the respective tooth space and by suitably pivoting or tilting the tool, the gear **36** can be turned step-by-step. After readjusting the gear **36**, the threaded opening **60** is closed by a suitably sealed plug **38** which at its forward inner end facing the insert **46** is provided with a radial projection **40** engaging the tooth space between two adjoining teeth **41** in order to lock the gear **36** when the plug **38** is threadably engaged within the opening **60**.

Thus, the adjustment of the stroke of the piston **18** is attained in a very simple manner by turning the gear **36**. In the exemplified embodiment of the present invention as shown in the FIGURE, the insert **46** is a separate element. However, it will be readily recognized that the connecting piece **34** may also be directly attached to the upper housing part **16** so as to form a one-piece element.

While the invention has been illustrated and described as embodied in a piston drive, it is not intended to be limited to the details shown since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

What is claimed as new and desired to be protected by LETTERS PATENT is set forth in the appended claims:

I claim:

1. A piston drive for actuating an element such as a valve, comprising:

a housing defining an axis and including a connecting piece provided with an external thread;

piston means operatively connected to the element and including a piston reciprocating in axial direction within said housing between two end positions;

first adjusting means for defining one of said end positions of said piston, said first adjusting means including a worm drive having a worm wheel acting upon said piston and provided with an internal thread in mesh with said external thread of said connecting piece so as to be movable in axial direction; and

second adjusting means accommodated in said housing for defining the other one of said end positions, said second adjusting means including a further connecting piece mounted to said housing and a gear extending in the path of movement of said piston and cooperating with said further connecting piece so as to be movable in axial direction, said gear being accessible from outside through an opening of said housing to permit adjustment thereof.

2. A piston drive as defined in claim **1** wherein said worm drive further includes a worm cooperating with said worm wheel and being actuatable from the outside for allowing adjustment of said worm wheel in axial direction.

3. A piston drive as defined in claim **1** wherein said further connecting piece includes an external thread, said gear including an internal thread in mesh with said external thread of said further connecting piece.

4. A piston drive as defined in claim **1** wherein said opening is constituted by a lateral bore provided in said housing in the area of said gear for allowing insertion of a tool between two adjacent teeth of said gear and to permit adjustment of said gear from the outside by turning said gear relative to said further connecting piece.

5. A piston drive as defined in claim **4**, and further comprising a plug for closing said bore, said plug including a radial projection engaging in a tooth space between two adjoining teeth of said gear for locking said gear.

6. A piston drive as defined in claim **1** wherein said piston means further includes a reinforcing element arranged between said piston and said worm wheel.

7. A piston drive as defined in claim **6** wherein said reinforcing element is provided with at least one downwardly extending projection engaging a groove in said housing for preventing a rotation of said reinforcing element and said piston.

8. A piston drive as defined in claim **6** wherein said reinforcing element is of metal.

9. A piston drive as defined in claim **8** wherein said reinforcing element is made of sheet steel.

10. A piston drive as defined in claim **6**, and further comprising at least one disk sandwiched between said reinforcing element and said worm wheel for allowing even transmission of forces exerted from said worm wheel to said piston.

11. A piston drive as defined in claim 1 wherein said piston means further includes a piston rod attached to said piston and linked to the element for transmitting the movement of said piston to thereby actuate the element.

12. A piston drive for actuating an element such as a valve, comprising:

a housing defining an axis and including a connecting piece provided with an external thread;

piston means including a piston reciprocating in axial direction within said housing between two end positions;

first adjusting means for defining one of said end positions of said piston, said first adjusting means including a worm drive having a worm wheel acting upon said piston and provided with an internal thread in mesh with said external thread of said connecting piece so as to be movable in axial direction, said piston means further including a reinforcing element arranged between said piston and said worm wheel; and

at least one disk sandwiched between said reinforcing element and said worm wheel for allowing even transmission of forces exerted from said worm wheel to said piston.

13. A piston drive for actuating an element such as a valve, comprising:

a housing defining an axis;

piston means operatively connected to the element and including a piston reciprocating in axial direction within said housing between two end positions;

first adjusting means for defining one of said end positions of said piston, said first adjusting means including a worm drive with a worm wheel acting upon said piston and being movable in axial direction, said worm wheel and said gear being actuable from outside through respective openings of said housing for movement in axial direction to thereby control said end positions of said piston.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,024,144

DATED : June 18, 1991

INVENTOR(S) : FRITZ MULLER

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Claim 13, column 6, line 18, after "tion" add -- ; and second adjusting means for defining the other one of said end positions, said second adjusting means including a gear extending in the path of movement of said piston and being movable in axial direction --.

Signed and Sealed this

Thirteenth Day of October, 1992

Attest:

DOUGLAS B. COMER

Attesting Officer

Acting Commissioner of Patents and Trademarks